THE COMPARATIVE COMPETITIVE ABILITY OF THIRTEEN *AGROSTIS STOLONIFERA* CULTIVARS TO *POA ANNUA*

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ABSTRACT

Poa annua has been an increasing problem on *Agrostis stolonifera* L. putting greens, especially with the lowering of the mowing height into the 2.5 to 3.8 mm range. Recently a number of new *A. stolonifera* cultivars have been released for use on putting greens. This investigation assessed the relative competitive ability for mature plants of 13 *Agrostis stolonifera* cultivars to *Poa annua* L. under very closely mowed putting green cultural regime of 3.2 mm. The relative competitive ability was assessed by the transplanting of mature monostands of *P. annua* into mature turfs of each of the 13 replicated *A. stolonifera* cultivars. Four *A. stolonifera* cultivars ranked superior in competitiveness with *P. annua*, including Penn G2, Penn G6, Seaside II and Penn A1. Ranking lowest in agressiveness under the very closely mowed conditions were Penncross and Pennlinks. Those *A. stolonifera* cultivars sustaining shoot densities above 2000 dm^{-2} usually exhibited the most vegetative competitiveness in suppressing the *P. annua* content in polystands. These findings suggest that significant cultural control of *P. annua* can be accomplished on closely mowed putting greens by the selection of certain *A. stolonifera* cultivars that can sustain very high shoot densities under a very close mowing.

Keywords

Close mowing; polystand composition; putting green; shoot density; vegetative

INTRODUCTION

Agrostis stolonifera is used as the preferred turfgrass species on putting greens in Italy. It is uniquely adapted morphologically for use on putting greens [Beard, 1982]. Extensive, prostate lateral stem development and a high-shoot density have been sustained under frequent, close mowing of 4 to 6 mm, depending on the cultivar. Recently the trend has been to lower cutting heights of 2.5 to 3.8 mm on putting greens.

Penncross has been the cultivar most widely accepted and used throughout the world for the past 35 years. Recently, a number of new *A. stolonifera* cultivars have been released, with some that can sustain extraordinarily high shoot densities and at very-low cutting heights of 2.5 to 3.2 mm [Croce *et al*., 1994; Croce *et al*., 1998; Sifers *et al*., 2001]. Historically, *P. annua* has been a significant problem on older putting greens [Beard *et al*., 1978]. The concepts and factors affecting competition among specific species within a turfgrass community may vary significantly between the initial establishment phase and the subsequent mature turfgrass polystand. Also, there are many factors that can affect the competitive ability which can be grouped as follows: a) turfgrass environment, b) cultural system, c) influence of turfgrass pests, d) intensity and type of use, and e) genetic constitution of the individual species and/or cultivars. A review of research concerned with the competitive ability among turfgrass species, including *A. stolonifera – P. annua* polystands, has been conducted by Watschke and Schmidt [1992].

The investigation of competitive ability of and *A. stolonifera – P. annua* polystand is best accomplished by a component analysis approach. The three major phases in turfgrass species competition are the a) seed germination phase, with *P. annua* seed having a specific light requirement, b) seedling plant competition stage, in which *P. annua* has a competitive edge during the cool temperatures of early spring and late autumn when a number of *A. stolonifera* cultivars are slower growing, and c) mature plant competition. Research has been in the first two phases, but there has been a decided lack of research for the third phase. This is especially true under the very-close cutting heights now being used on putting greens and also with the newer high-density cultivars that have been developed for these closely mowed conditions. Thus, the objective of this investigation was to determine the comparative competitive ability of 13 *Agrostis* cultivars to *P. annua* under a very-closely mowed putting green cultural regime.

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MATERIALS AND METHODS

Establishment

Eight commercially available cultivars of *Agrostis stolonifera* – Cobra, Penncross, Penneagle, PennLinks, Providence, Putter, Southshore and SR 1020 - were planted onto 600 m^2. The specially constructed experimental putting green located in Torino Golf Club (45.2°N and 7.5°E). The plot size was 2.0 x 3.5 m, arranged in a randomized block design with four replications. In addition, five genotypes that were advanced experimental selections of *A. stolonifera* from Pennsylvania State University – Penn A1, G1, G2, G6 and Seaside II - were planted in an adjacent area at the same time. These plots were 2.0 x 1.75 m in size, and arranged in a randomized block design with two replications. The root zone profile construction was a high-sand composition meeting USGA/Texas specifications, including a gravel drain bed and subsurface drainage system. The root zone pH was 6.8.

The experimental area was planted on 4 May 1992. Preplant fertilization consisted of 1.0 kg 100 m^{-2} each of nitrogen, phosphorus and potassium incorporated into the upper 100 mm of the root zone. All cultivars were planted at the seeding rate of 0.5 kg 100 m^{-2}, with the seed lightly raked into the surface. Vertical barrier boards were used to avoid contamination of seed between plots. No lateral movement occurred and successful turfgrass establishment was achieved with distinct perimeters between individual cultivar plots.

Cultural practices

During this study the cultural practices on the experimental putting green involved mowing six times per week in multiple directions. A 3.2 mm effective cutting height was sustained by means of a triplex greensmower with the groomer attachment, and the clippings removed. The nitrogen fertilization program consisted of 0.375 kg 100 m^{-2} per growing month from March through October, totaling 3.0 kg 100 m^{-2} annually. The base phosphorus and potassium levels were applied as needed to maintain the nutrient levels in the high range based on an annual chemical soil test. Supplemental water was applied as needed to prevent visual wilt of the turf, and was achieved via gear-driven, pop-up heads arranged in the tight spacing 2.5 m that sustained uniform moisture conditions across the experimental area. Topdressing was practiced at two-month interval during the growing season at a rate of 0.16 m^3 100 m^{-2}, using the same mix composition as the underlying root zone. No turf cultivation or vertical cutting was practiced on the turfed plots, to avoid interplots genotype contamination.

Disease and insect problems were minimal, except for dollar spot (*Sclerotinia homoeocarpa* F.T. Bennett), which was allowed to develop with no fungicide applications made during 1993 growing season, in order to assess the relative cultivar susceptibility (Croce *et al*., 1993). A modest preventive fungicides program has been followed since 1995. No insecticides or herbicides have been applied. All emerging weed were manually removed during the 1992 growing season. Subsequently after the turfs had fully stabilized, weed were allowed to develop across experimental area.

Treatments

A single 108 mm diameter mature turf plug of *P. annua* was transplanted into each replicate cultivar plot of the 13 *A. stolonifera* cultivars. The *P. annua* turf plugs were

Table 1. Comparative percent *Poa annua* persisting from the original 108 mm diameter transplanted turfed plugs that were being invaded by each of thirteen *Agrostis stolonifera* cultivars.

Cultivars	Percent *Poa annua* content										
	5/13/98	6/30/98	8/13/98	9/30/98	4/9/99	5/11/99	6/16/99	7/2/99	8/9/99	8/30/99	9/16/99
Southshore	90.9	100.7	72.6	83.1	83.8	70.8	57.9	46.1	43.1	32.7	20.1 a*
SR 1020	87.5	97.3	78.8	94.6	90.7	76.2	63.7	49.4	42.0	39.3	27.8 a
Putter	97.5	100.7	77.8	73.6	91.4	81.0	63.0	60.8	50.4	42.0	30.5 a
Cobra	103.1	102.6	83.3	80.1	92.9	72.7	69.4	51.6	44.0	36.4	33.5 a
Penneagle	94.0	101.6	82.0	86.0	88.2	73.7	67.1	57.2	41.1	29.2	36.0 ab
Providence	98.1	103.4	75.5	76.2	87.5	62.2	74.1	48.3	51.5	36.3	37.3 b
Pennlinks	92.1	102.2	73.9	80.6	85.5	85.8	64.4	56.0	53.7	55.3	51.5 bc
Penncross	96.4	103.5	74.4	84.3	92.5	77.8	73.7	59.7	59.5	50.0	58.4 c
LSD (P=0.05)	5.76	10.92	15.16	17.50	12.55	12.07	15.50	7.22	5.12	13.78	17.16
Penn G2	93.7	75.5	53.3	46.6	32.2	30.9	36.4	19.4	17.6	8.7	0.0 a
Penn G6	84.0	77.6	54.9	54.9	37.7	38.7	35.7	22.5	26.1	0.0	3.9 b
Seaside II	90.1	85.9	60.1	55.1	70.7	53.9	42.3	39.3	37.1	24.8	3.9 b
Penn A1	91.0	75.7	62.0	51.5	48.7	34.9	41.7	28.3	27.5	16.0	8.7 b
Penn G1	94.6	77.5	51.7	60.5	51.7	50.9	36.9	27.1	24.9	11.8	23.6 b
LSD (P=0.05)	19.53	35.52	19.67	24.57	22.00	26.11	15.18	10.33	23.57	25.54	23.18

*** Means followed by the same letter(s) in the same column are not significantly different at the 5% probability level based on the Duncan's test.**

obtained from the nearby five-years old putting green. The same study and procedures were conducted in both 1998/1999 and 1999/2000. The plugs were transplanted on 23 April 1998 for the first study and on 20 December 1999 for the second study. The data presented will be for the first 1998-99 study, as the second 1999-2000 study confirmed the results of the first study.

Assessments

The inward *A. stolonifera* shoot invasion or outward *P. annua* shoot encroachment were measured at approximately 30- to 45-day intervals through the April to October growing season. The base reference used was a template ring of the 108 mm diameter perimeter placed over the original *P. annua* turf plug, which had a surface area of 91.5 cm^2. Then two perpendicular diameters of the current *P. annua* perimeter were measured, a mean diameter calculated, the corresponding surface area calculated, and the percent *P. annua* area compared to the original turf plug was calculated.

Morphological assessments of the 13 cultivars of *A. stolonifera* turfs were made in September of 1995, 1997 and 2000. They consisted of actual shoot density counts conducted on a 1,600 mm^2 area of turf from each replicate plot.

All data were summarized at the end of each growing season and processed for statistical assessment with the analyses of variance for the eight older cultivars being analyzed separately from that for the five new cultivars.

RESULTS AND DISCUSSION

Competitive Ability

The relative vegetative competitive abilities of thirteen *A. stolonifera* cultivars against a monostand of *P. annua* over a two-year period are shown in Table 1. Following the 23 April, 1998 transplanting of the *P. annua* turf there was a small decline in the area occupied by *P. annua* on May 13 for all cultivars, except for Cobra. This was followed by an increase in the area of the *P. annua* between May 13 and June 30 for all eight of the older cultivars, and a decreasing trend in the area occupied by *P. annua* in the case of the five newer cultivars. Between August 13 and September 30 of 1998 there was a trend to an increasing *P. annua* area in six of the eight older *A. stolonifera* cultivars, whereas in the case of the five newer cultivars there was a decreasing trend in the *P. annua* area for three of the five cultivars, with the exceptions being Penn G6 and Penn G1. During 1999 growing season for the first study there was a decreasing trend in the size of the *P. annua* area for most *A. stolonifera* cultivars. A distinct shift was noted to an intermixed polystand of *P. annua* and *A. stolonifera* as the dominance of *P. annua* decreased below 50% of the original transplanted diameter.

Four *A. stolonifera* cultivars ranked superior in competitiveness with *P. annua*. They were in ranked order: Penn G2, Penn G6, Seaside II and Penn A1. Ranking the lowest in aggressiveness against *P. annua* under very-close mowing conditions were Penncross and PennLinks. These data indicated it is possible to achieve improved

Table 2. Comparative shoot density counts of thirteen closely-mowed *Agrostis stolonifera* cultivars.

Cultivar	Shoot density count (dm^{-2})			
	1995	1997	2000	mean
Southshore	1692 a*	2037 a	1595 a	1775
Pennlinks	1553 ab	2186 a	1431 ab	1723
Providence	1395 b	2080 a	1494 ab	1656
Cobra	1363 b	1873 ab	1622 a	1619
SR 1020	1523 ab	1876 ab	1453 ab	1617
Putter	1356 b	1814 ab	1244 ab	1471
Penneagle	1383 b	1522 b	1398 ab	1434
Penncross	1358 b	1631 b	1119 b	1369
LSD value	214	376	342	487
Penn G6	2700 a	3003 a	2199 a	2634
Penn A1	2325 a	2868 a	2175 a	2456
Penn G2	2366 a	2725 a	1941 a	2344
Penn G1	2228 a	2675 a	1772 a	2225
Seaside II	1475 b	2550 a	2241 a	2089
LSD value	538	1333	456	797

***Means followed by the same letter(s) in the same column are not significantly different at the 5% probability level based on the Duncan's test.**

cultural control over *P. annua* via the use of high-density *A. stolonifera* cultivars that can sustain high shoot densities under very closely mowed putting green conditions.

Shoot density

A high shoot density usually is preferred for putting greens as it results in a narrower leaf width and a more vertical leaf orientation that contribute to a more uniform surface for ball roll (Beard, 1982). A high shoot density also results in the turf being more competitive against weed, moss and algae invasion. The comparative shoot densities of the 13 *A. stolonifera* cultivars maintained under closely mowed putting green condition in a Mediterranean climate are shown in Table 2. Ranking highest in shoot density were the newer cultivars – Penn G6, Penn A1, Penn G2, Penn G1, and Seaside II. Those *A. stolonifera* cultivars that sustained shoot densities above 2000 dm^{-2} usually exhibited the most competitiveness in suppressing the *P. annua* content in polystands maintained under very-closely mowed putting green conditions.

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